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Volume II. *July, 1893.* *Whole*
Number 4. *Number 10.*

THE

PHILOSOPHICAL REVIEW.

INTERNAL SPEECH AND SONG.

AN interesting field of exploration has in recent years been opened to us in the sphere of the psychology and physiology of speech. The results accruing from analysis and experiment, and more especially from the study of the pathology of speech, have been most instructive. The similar problems, involved in the reproduction of musical sounds, have had little attention, strange to say, despite the analogous terms in which they may be stated. It is of some aspects of these two facts — "internal speech," the *parole intérieure* of the French, and "internal song," the *chant intérieur* — that I wish to speak in what follows, especially in the way of interpreting the results now widely accepted, in terms of our general psychological theory. What happens, when we have "words in our minds" and "tunes in our heads?"[1]

I. INTERNAL SPEECH.

The doctrine of brain function in speech is now pretty clear — thanks to the teaching, principally, of pathological cases. Normal speech is a function which probably involves several so-called 'brain centers,' all in dynamic connection with one another. Given a man with the physical apparatus of the act of speaking intact — vocal organs, nerve connections, and brain seat of discharge (Broca's gyre) — and ask why such a man speaks, the answer may take several forms. He may name a word-sign which he *sees*, or repeat a word sound which he *hears*, or tell the words he has *written*, or finally, he may speak a word simply from the *habit* of speaking it — from the tendency of his speech-apparatus to operate as it has operated before. Now we ordinarily generalize this diversity in the case in which the man 'thinks' the word merely without speaking it, by saying that the word is 'in his mind,' internal, *intérieur;* but the question is: What is in his mind? — the printed word (visual image), the spoken word (auditory), the written word (hand-motor), the articulate word (speech-motor) — is it all of these? Is it any of them?

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[1] A further interesting question concerns "internal writing," *i.e.*, what have we in mind when we think of written words? — visual figures, visual hand- or pen-movements, muscular sensations of movement? This is interestingly discussed by Goldscheider, *Archiv für Psychiatrie*, XXIV, 1892, p. 503, reviewed by the present writer in the forthcoming number of the *American Journal of Psychology*.

If we agree to call the motor center for speech, the 'intrinsic' source of stimulation to the organs of speech, and, on the other hand, to call the other centers pointed out, 'extrinsic,' the question now current runs: Are these extrinsic centers capable, each for itself, of arousing the speech center; or does one of them, the center for sensations and memories of actual movement, the 'kinaesthetic' word-center, always stand between the motor seat and the other sensory centers? Or, put psychologically, do we, when we remember words and speak them, always recall them in terms of the sensations of movement involved in speaking or writing them; or is it possible to speak simply from remembering the visual form of the word or its sound? Is the kinaesthetic center intrinsic or extrinsic?

The view that verbal memories are always motor (kinaesthetic) is associated with the name of Stricker.[1] Recent results have refuted Stricker. A variety of facts have been adduced to show that the function of speech is not dependent in all cases upon the possibility of reinstating motor experiences. Many of these facts are already common property; but a few of the latest points on this side of the discussion are these: (1) Cases are cited of verbal hallucination, in which the patient hears two (or more) voices, one of which he takes to be his own, the other that of some one else; only the former can be accounted for as due to the incipient stimulation of his own speech centers, the other is probably auditory.[1] This interpretation is supported by the interesting fact, established by Pierre Janet, that some patients can themselves speak during their verbal hallucinations, while others can not. Again, only of the latter class must we hold that the motor memories are necessary to speech.[2] Indeed, there is a characteristic difference between the two classes — a difference first pointed out, it seems, by Baillarger — *i. e.*, with those patients who are able to speak without interrupting the voice which they hear, we have a hallucination of *objective* speech: they hear what they think is a real voice outside them. While the other class have a hallucination of *internal* speech. They declare that there is some one inside them, speaking to them. Séglas holds, with evident truth, that these latter hallucinations are 'psycho-motor'[3] in their seat, while the 'objective' kind are auditory. (2) There are cases of motor aphasia due to impairment of hearing, the motor centers being intact, *i. e.*, cases of auditory verbal amnesic aphasia.[4] (3) We recognize and understand words which we are unable to pronounce and which we have never written; this recognition must be by aid of visual or auditory images. The part played by the visual and motor memories respectively, in my own case, is seen in the fact that when I wish to speak in any language but English, the German words come first into my mind; but when I sit down to write in a foreign language, French words invariably present themselves. This means that my German is speech-motor and auditory, having been learned conversationally in Germany, while the French, which was acquired in school by reading and exercise-writing, is visual and hand-motor.[1] It is interesting also to note the joyous recognition which young children show, when they speak a new vowel or consonant sound correctly. The memory of the correct sound can not, in this case evidently, be from the motor centers.[2] (4) There is evidence of direct functional connection between the visual (and auditory) seat and the center of motor discharge. Here I may best give the words of Janet, who writes in view of the pathological evidence: "this hypothesis is confirmed by investigations on anaesthetic hysterics. In my opinion, it is impossible to explain the fact that these persons preserve their power of movement intact, in spite of the absolute loss of kinaesthetic sensations and images, unless we admit that movement may be directly stimulated by visual and auditory pictures. There are individuals with whom the auditory image of a word suffices for its pronunciation.'[3] (5) The law of 'dynamogenesis,' in accordance with which every sensory stimulation tends to bring about a motor discharge, indicates such a direct connection in cases of closely associated function. Féré demonstrates that speaking makes the hand-grasp stronger, that seeing colors and hearing sounds influence the motor centers; so it is altogether probable that stimulations of sight and hearing react directly to stimulate the motor speech centers.[4] (6) Cases may be cited of direct antagonism between memories of words and the sensations produced by the speech-movements which they stimulate. The pathological state called paraphasia is duplicated sometimes temporarily in cases of severe sick headache; one intends to mention one object (chair) and really speaks another (spoon) without detecting the mistake. I have myself had this experience; being quite unable to name correctly an object seen until someone else has spoken the word with emphasis — yet all the while allowing the incorrect word spoken to pass, and feeling astonishment that others have not understood my meaning. Similar are those cases in which patients take their own words for those of some one else, declaring, when questioned, that they themselves did not speak them.[1] Reflection leads us to the view that in these cases there is a direct flow from the auditory or visual center to the motor speech center, the kinaesthetic speech center being perhaps temporarily inhibited. The same kind of antagonism is also seen, from the other side, when there is 'exaltation' of the kinaesthetic center, or what is called uncontrollable 'verbal impulse.' The patient speaks certain words or phrases in spite of himself — against his utmost effort to speak something else.[2]

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[1] Stricker, *Ueber die Bewegungsvorstellungen*, *Ueber die Association der Vorstellungen*, *Ueber die Sprachvorstellungen*, *Langage et Musique*. See also G. E. Müller, *Grundlegung der Psychophysik*.

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[1] See case of Charcot quoted by Ballet, *Le langage intérieur*, p. 64, also cases in Séglas, *Les troubles du langage chez les aliénés*, p. 126.

[2] Cf. *Revue Philosophique*, Nov. 1892, p. 520, and Séglas, *loc. cit.*, p. 117 and p. 145. A case is reported of a patient who could stop his internal voice by holding his breath (*Annales psychol.*, Jan., '93, p. 103).

[3] Séglas, *loc. cit.*, p. 147; Janet, *loc. cit.*, who advocates the expression "kinaesthetic verbal" instead of "psycho-motor," as applying to this hallucination of internal speech.

[4] See cases collected by Ballet, *loc. cit.*, pp. 91-92; also Bastian's case, *Brain as Organ of Mind*, p. 642; cf. also Paulhan, *Revue Philosophique*, XXI, pp. 37 ff.

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[1] A similar case is reported by Ballet, *loc. cit.*, p. 62.

[2] At the risk of too much personality (of which, however, the literature of this topic is necessarily full), I may quote the following about a two-year-old child, written in a letter by her aunt, who was far from intending it as a psychological observation or for publication: "She rejoices greatly, when she succeeds in sounding a new letter. The other day she achieved *l*, and went about telling everybody, 'Baby can say sleep and slipper.' This morning I am informed that she can say 'save' and 'give' (letter *v*). She notices at once herself, when she can pronounce the word as the rest of us do — no one tells her."

[3] Pierre Janet, *Automatisme Psychologique*, p. 60. The common cases of patients who can *copy*, when they can not *initiate* writing and speech, are in evidence.

[4] Féré cites his results in support of Stricker's contention; see his *Sensation et Mouvement*. He fails, however, to distinguish between the direct motor effect of a sensation, and the roundabout motor effect — *i.e.*, through the kinaesthetic center — which latter is required by Stricker's view.

This conception of the case — not to dwell upon other points of evidence[3] — seems to harmonize well with the doctrine of nervous function now becoming more and more current. According to this doctrine, the brain is a series of centers of relatively stable dynamic tension; the various associative connections among these centers are paths of *less and more* rather than of *least and most* resistance; that the range of alternative adjustments is excessively wide; and, consequently, that any individual has his 'personal equation' in all functions as complex as that of speech. One man is a 'motor,' another a 'visual,' a third an 'auditive,' according as one or another of the extrinsic sources of stimulation suffices to release the necessary energy into his motor speech center. No one doubts Stricker, therefore, when he says that he remembers words only by means of sensations of incipient movement; but for the same reason we cannot dispute the claim of Stumpf, and Wernicke, and Kussmaul, and Lichtheim, that auditory and visual images may, in other cases, play an equally leading rôle.

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[1] See Séglas' very interesting cases, *loc. cit.*, p. 150 f.

[2] See Séglas on "hysterical mutism," *loc. cit.*, p. 97 f. In dreams this is probably the case: the kinaesthetic centers are no longer inhibited, and we talk meaningless sounds, which in our dream consciousness are interpreted as rational discourse. In view of all such cases of antagonism, a distinction may be legitimate between *psychic* and *cortical dumbness*, corresponding to the current distinction on the sensory side. Just as there is a distinction between being unable to hear words (cortical deafness) and being unable to understand the *meanings* of words we hear (psychic deafness), so there is a distinction, shown pathologically, between being unable to speak words, and being unable to speak the words we *mean*. Put in different terminology, the former case would be due to a lesion of the motor elements at the 'second level,' and the latter case to a lesion of the motor connections between the second and the 'third level.'

[3] For instance, cf. Stumpf, *Tonpsychologie*, I, pp. 160 ff. Further evidence accrues, also, from the consideration of tune memories below.

Assuming, then, this answer to the question of the antecedents of speech, some additional considerations arise which have not hitherto been suggested, as far as I am aware. In the first place, I find in my own case and from experiments with others, that the presence or absence of elements of movement in the consciousness of a word depends in many individuals largely upon the direction of the attention.[1] If the attention be directed to the vocal organs — either one's own or some one's else — movements of the tongue, lips, and larynx are clearly felt in the organs, and sometimes by touch, and may be seen. If, on the other hand, the attention be directed to the ear, and the words be thought of as heard, these muscular sensations fall perceptibly away or disappear. This indicates that there are two great speech-types, a motor type and a sensory type, according as the attention is given in one direction or the other — a distinction which is now familiar in connection with reaction-time experiments. The reaction-time is shorter in so-called 'motor' reactions. I have experimented to some extent with a view to finding in what per cent. of individuals one kind of hand-reaction is normal as against the other kind. The results show that, among uninstructed groups of students, reacting for the first time in the laboratory, about one-quarter of the entire number, when questioned immediately after giving a series of reactions, were clearly conscious of having paid attention to the hand (motor attention). The average time of their reactions is considerably lower than the general average. This result shows clearly, not only that the difference in time of the two kinds of reactions is a real difference; but also that there are individuals who normally react most readily, and most effectively, in one way or the other.[1] The bearing on speech is this : it becomes at once evident that the most rapid speakers are generally *ceteris paribus* 'motors' in their type. The direction of the attention serves to arouse the organs of speech in advance by an influence, the nature of which is discussed below.[2]

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[1] Paulhan notices the influence of the attention (*loc. cit.*, p. 43), but does not inquire into it; so also does de Watteville, I fancy, from references I have seen to an article of his (*Progrés Medicale*, March 21, 1885) which I have been unable to procure.

The further questions arise: Is a person motor, visual, or auditory, in his speech, and in his reactions generally, because he has strengthened a particular kind of memories by the prevailing concentration of his attention upon them? Or does he give motor or sensory attention and reaction, because of the predominant strength of a certain class of his memories? Probably both of these positions are true : and each of them is of great importance in the education of speech, and other motor functions. The case is simply the exhibition, on a large scale, of what we find to be true of the relation of attention to sensations generally. Increased intensity of sensation tends to draw the attention ; and the attention increases the intensity of sensations. It is one of those processes of 'reasoning in a circle' which characterize the growth of body and mind together. Another instance is this: pleasure arises from healthy function, while healthy function is directly assisted by pleasure.

The case before us is capable, however, of a closer psychophysical explanation. We know that increasing intensity of sensation liberates energy increasingly toward the motor centers. It is probable, therefore, that a given degree of intensity of each particular sense-quality involves as an element in its conscious value a motor ingredient — be it in part an element of consciousness from the potential condition of the motor centers themselves, or in whole from the kinaesthetic centers. The distinction between sensory and motor consciousness is largely logical : all consciousness is both. Every sensation reverberates outwards in the muscles and this muscular resonance reacts upon the sensory factor. It is clear that the largest amount of the motor 'ingredient' attaches to the most intense sensation. Now we also know that the exercise of attention involves a large amount of motor innervation ; its constant and necessary accompaniments are motor. Consequently the rising tide of motor incitation due to the rising intensity of sensation is at once an increasing relative stimulus to the attention.

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[1] See the further position on this subject below.

[2] To quote my own case again — I find it impossible to reproduce a French sentence without keeping my attention on the visual picture of the printed signs ; but I can follow a German sentence by memories of speech movements with no trace of visual attention.

On the other hand, the ordinary opinion is true, that the idea of a movement is already the beginning of that movement. In the light of this principle it is easy to see that, when I turn my attention to a sensation, I in so far start into more vigorous existence the motor ingredients of that sensation. This in turn brings out more intensely the sensory ingredients — and the second aspect of this 'reasoning in a circle' is made clear.

To put the matter in a nutshell — just in as far as the motor ingredient is large, that is, in as far as the sensory ingredient is intense, just to this degree will the direction of the attention be secured, on the one hand, and both the ingredients intensified by this act of attention on the other hand. The two facts, therefore, that intensity draws attention and attention increases intensity may be stated in terms of a single principle which I venture to call the "law of sensori-motor association," *i.e., every sensational state is a complex of sensor and motor elements, and any influence which strengthens the one, tends to strengthen the other also.*

The reflex attention which follows upon increased intensity of sensory excitation is, therefore, the *Nachklang* of revived motor associates ; and the increased intensity which follows the direction of the attention is the *Nachklang* of revived sensory associates.

This principle also goes far to explain the relation to each other of the two so-called laws which are usually stated independently in connection with reaction-times : (1) greater intensity of stimulus diminishes the reaction-time, and (2) motor reactions are shorter than sensory reactions. Both are ready deductions from the "law of sensori-motor association." More intense stimulation gives a shorter reaction than less intense, because it arouses more and stronger motor associates ; or, put physiologically, because it has greater dynamogenic effect, and so facilitates motor discharge. This is clearest, when the signal is foreknown and the attention is consequently not drawn to it. But this means, when a particular kind of motor association is emphasized by the direct act of earlier attention. Now this is the second case — motor reaction. The motor associates are pictured, dwelt upon, emphasized beforehand, the motor centers are put into a state of high potential, the stimulus is left to discriminate itself without attention — and thus the reaction time is shortened. It is evident that in the sensory reaction, part, at least, of the dynamogenic influence of the stimulus goes into the attention (discrimination of signal) ; while, in the motor reaction, it all goes into the reaction, which is already prepared for, besides, by motor attention.[1]

Applying this thought to the rise of speech and its method, we find abundant reason for the variety of types found among adults. Visual, auditory, and motor memories of words date back to early childhood, and do not arise synchronously. Visual pictures of figure arise and get comparatively fixed in childhood some months before the child begins to speak or write, as is shown by its recognition of simple figures, animals, and later letters. Its auditory images, however, date back still farther : this is seen in the very early recognition of words heard. The motor (speech and writing) memories, on the contrary, are the latest of all. The ability to trace 'copies'[1] recognized, arises only after considerable progress has been made in speaking, and the progress in speaking is, in turn, relatively much later in its rise than visual and auditory recognition. So the probable order in which these different elements of the speech faculty would come under the jurisdiction of the "law of sensori-motor association" is about this: auditory, visual, speech-motor, hand-motor (writing) memories.

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[1] It is only what we would expect that, when the stimulus (signal) is not intense enough to carry its own discrimination, either the reaction takes place upon a false stimulus, or the attention shifts and the time is lengthened.

This means that auditory and visual memories get a good 'start' on the other varieties in the genetic process. They acquire considerable influence over the attention, which is largely reflex at that early period, and they become in turn relatively easy of revival, before the specific motor memories are well begun. Here is sufficient reason for the existence of auditory and visual speech types. Habits thus arise which, on the mental side, express the readiest sensori-motor associations. They amount to what some have called 'pre-perceptions,' or better, perhaps, 'pre-apperceptions.' On the physical side these habits represent preferential dynamic tensions among those paths of discharge whose convergence is towards the brain seat of attention. The law signalized above, tends of course, as life advances, to consolidate these particular sensori-motor couples: and they become permanent traits of the mental life, unless the other speech connections, which are subsequently brought into use, be of sufficient strength to supersede them. This latter, however, may happen in any of several instances: either from inherited tendency, or from the strength of other motor habits, as walking, etc., or, in course of time, by dint of continued practice.

It would seem, accordingly, that the 'auditory speech' type should be found most frequently among unliterary people and among those who have not had extended linguistic training or large practice in writing and reading. The particular influences which are lacking in this type are present in the 'motor type.'

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[1] What I have called "tracery imitation," *Science*, XIX, 1892, p. 19 f, discussed also by Goldscheider under the equivalent phrase, *malende Reproduction* in *Archiv für Psychiatrie*, XXIV, 1892, p. 503.

It would be interesting to note the effects following, in this respect, upon the different methods of instruction in the primary and secondary schools. If speech is so fundamentally interwoven with thought and mental growth, the method and means of language study which emphasize conversational and written expression must be most valuable. And it may be that, even in the college course of four years, valuable auxiliary training may be had from the 'recitation' or oral method, as opposed to the exclusively 'lecture' method with only written tests.

I may add also a word of practical application on the subject of the psychology of reaction times. We have in this fact of types the explanation of the contradictory results reached by different investigators in the matter of motor reactions. Some find motor reactions shorter, as I have said above; others do not.[1] The reason is, probably, that in some subjects the 'sensory' type is so pronounced that the attention can not be held on the muscular reaction without giving confusion and an abortive result. On the other hand, some persons are so clearly 'motor' in ordinary life that sensory reaction is, in like manner artificial, and its time correspondingly long. And yet again others may be neutral as regards sensor or motor preferences. If this be true, another element of "abounding uncertainty" is introduced into all the results of experiments so far performed in this field, as reflection on the matter will show. It might well be a matter of very great importance in connection with astronomical observations: a source of error which could not be eliminated by any amount of instruction to the observer as to the method of his attention.

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[1] As illustrating this state of things, I may refer to the brief article (just come to my hands as I send this to print) by Prof. Cattell in *Philosophische Studien*, VIII, (1892), p. 403. He reports variations in experimental results which do not confirm the general law that motor reactions are shorter. At the same time Prof. Cattell attempts to apply as universal the principle that attention to a voluntary motor combination tends to derange it—and so he "would expect" the motor reaction to be *longer*. Now, as it seems to me, this principle applies largely to such movements as have already become so 'automatic' as to be practically reflex, *i.e.*, out of conscious supervision altogether. In saying, "in speech, writing, reading aloud, etc., the attention is always directed to the end in view (*Ziel*), never to the movement," Prof. Cattell overlooks altogether the 'motor' type of reagent and goes directly in the teeth of the teaching of the pathology of speech. Stricker says the motor images are exactly and only what he pays attention to. What shall we say of Sommer's and Pick's citations of cases in *Zeitsch. für Psychologie*, vol. ii, 143 and iii, 48. As a matter of fact, I think the reactions which we perform in the laboratory (moving second rather than first finger, right rather than left hand) are so evenly voluntary throughout that the principle suggested by Prof. Cattell has little appreciable influence one way or the other; although in a person of decidedly sensory type some embarrassment might arise from it. I hope to return to this subject with some figures of my own: my note in the *Medical Record* (N.Y.), April 15, 1893, p. 455, may be referred to.

And another inference: Why may not reaction-time results be used as a means of *diagnosis* of speech-troubles? Given an aphasic patient with an unusually short reaction-time, he would be *probably* (1) motor in type, and, consequently, *probably* (2) afflicted with trouble in his motor region. On the other hand, a patient with a very long reaction would be auditory or visual in his type. This would require cases of almost artificial simplicity of symptom and lack of 'sympathetic' disturbance; but it might be tested by observing the reaction time of patients, the seat of whose brain trouble is already known.

II. INTERNAL SONG.

The question of 'internal song' is a new one. What do we mean, when we say that a 'tune is running in our head'? The factors involved are evidently less complex than those involved in speech, at the same time that the entire phenomenon is more obscure. Evidence goes to show that the internal tune is almost entirely auditory: that is, that the auditory center is intrinsic to musical reproduction — Stricker again to the contrary notwithstanding.

An adequate discussion of the nature of tune reproduction should provide a theory of tune perception which takes account of three factors — pitch, time or rhythm, timbre — and possibly of a fourth character, ordinarily designated by the phrase 'musical expression' or, more properly, emotional tone.[1]

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[1] There is not a great deal of literature on this topic; see the following titles: Egger, *La parole intérieure;* Stricker, *Langage et musique;* Stumpf, *Tonpsychologie*, i, pp. 135 ff.; Walleschek, *Vierteljahrschrift für Musikwissenschaft*,

There are certain interesting points of relationship between internal song and internal speech. For example, many persons find internal tunes generally fuller, more real, and sometimes only tunes at all because they remember the appropriate words, because they have sung the words to the tune, or at least, because they have hummed the refrain aloud. Here there is clearly a motor type of music performers. But this motor requirement is extremely variable. In some cases the tune must be associated with a particular instrument, and this is done only by the reproduction of the proper sensations in the finger tips, lips, etc., used in playing that instrument. On the other hand, there are facts which show that the motor type is only a type, and that even in these cases auditory tune memories are necessary. Musical recognition in childhood often precedes verbal recognition. Musical expression usually precedes verbal expression, both when there is a clearly inherited musical tendency,[1] and in ordinary imitative reactions.[2] In cases of 'absolute hearing'—discussed below—we have apparently recognition of pitch without any motor-speech or song-images. Further, there is the critical fact that motor aphasia, and even verbal deafness, may exist with no impairment of the musical faculty—no *amusia*, as defects of musical faculty are called by Brazier. This is true both for musical recognition (case of Wernicke), and for musical expression.[3] Cases show, however, that the latter, musical expression, is never lost without involving speech; although musical recognition seems sometimes (Carpenter's case) to be lost without impairing speech. The conclusion that musical reproduction is auditory is supported also by such facts as the following: that we often recognize an air after hearing it once, even when

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1891, heft 1; Lotze, *Medicinische Psychologie*, p. 480; G. E. Müller, *Grundlegung der Psychophysik*, p. 288; besides the voluminous literature of aphasia. An interesting late article, full of bibliographical references, is by Brazier, *Revue Philosophique*, Oct., 1892, p. 337.

[1] Interesting cases are cited by Ballet, *loc. cit.*, p. 24.

[2] My child E. imitated a run of three notes, vocally, long before she showed any verbal imitations whatever.

[3] Cf. v. Franckl-Hochwart, *Ueber den Verlust des musikalischen Ausdrucksvermögens* in *Deutsche Zeitschrift für Nervenheilkunde*, I, p. 283.

we have never tried to sing it, and could not if we tried; that in singing or humming a tune, we know that we are wrong even when we are unable to correct it; tune hallucinations are reported without words or vocal quality, and, similarly, illusions stimulated by accidental sounds;[1] many persons are able to remember and recall musical chords and combinations which it is impossible for the human voice to reproduce, *i.e.*, we can mentally depict harmony; further, there are cases of persons who can recognize the pitch of tones from instruments, but not of the tones of their own voice.[2] It seems, indeed, on the surface clear, that of the elements distinguished above as essential to musical reproduction — pitch, rhythm, timbre, and emotional tone — the most essential, pitch, finds no adequate basis in motor speech or song memories. The range of intonation in speaking and singing is too narrow to supply the material for musical reproduction, although there are, no doubt, individuals whose musical capacity — especially of expression — is confined to these limits.

It is probable, accordingly, that there is a brain-center for tune memories — a center whose impairment produces so-called *notal amusia* — that this center is a part, in function, at least, if not anatomically, of the auditory center, and that cases will occur in different persons, of partial amusia, due to the degree in which this function involves others.[3] This general conclusion is confirmed, I think, by what follows on pitch memory, the only one of the four elements of musical reproduction which I am able to discuss in this paper.[4]

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[1] Ordinary internal tunes are usually stimulated in this way, as I have found by analysis of a great many such tunes at the time of their occurrence.

[2] Cases of v. Kries cited below.

[3] For example, musical deafness without verbal deafness; case of Grant Allen in *Mind*, III, p. 157, and that of Brazier, *loc. cit.*, p. 359. Bastian, *Loc. cit.*, p. 664, quotes a case from Lasègue of an aphasic musician, who could write nothing but passages of music which he had *just heard*. A recent case of Pick's (*Arch. für Psych.*, 1892, p. 910) seems at first sight to give trouble, *i.e.*, a case of loss of musical *recognition* with no impairment of musical *expression*. Yet Pick's location of the lesion as *subcortical* sufficiently accords with the view in my text. The seat of auditory *attention* was not injured. Cf. note on Pick's position below in this article.

[4] I hope, however, to say something on the psychology of musical 'time' and 'expression' later.

III. Pitch Recognition.

The recognition of the pitch of notes gives two cases apparently distinct from each other, *i. e.*, 'relative' and 'absolute' pitch recognition. In relative recognition the musical interval seems to supply the real *locus* of the recognition. Given the initial note (and the proper rhythm) — and the rest of the tune comes up by reason of the associated tone intervals, note by note. Comparatively few persons lack the ability to carry through a familiar tune mentally. Absolute recognition, on the other hand, is a different accomplishment; even among competent musicians it is often[1] conspicuously absent. It is the power of reproducing a note of any desired pitch absolutely from memory.

The auditory character of all relative pitch recognition is shown by the following facts — in addition to the general considerations already adduced : (1) Brazier[2] cites cases of aphasic patients who could speak words only by singing them : that is, they must first recognize an air, and then arouse the motor speech function from that cue. The motor center not being available in these cases, it is difficult to see on what but auditory grounds the tune recognition could proceed. It often occurs, in my own case, that I can not recall the words of a song until I get the tune started (of which a case is cited immediately below). (2) I find it possible, with Paulhan,[3] to think different notes very clearly while the vocal organs are held rigid. I am able to think one note while I am uttering aloud a long-drawn-out vocal sound (say ā) in a different pitch. And lest it may be said that it is the overtones which are heard internally in this case, I may add, that I am able with the greatest ease to hold aloud an ā sound at c′ (say), and at the same time to cause a whole tune — say Yankee-doodle — to run its course "in my ear." Stricker's inability to think one consonant while speaking another is due, probably, to the fact that in uttering labials, etc., pronounced and explosive muscular combinations are necessary, and that they have no clear auditory character being usually merged in accompanying vowel sounds. (3) My internal tunes have very decided pitch — determined upon an instrument in a number of cases. Yet it is not always the normal pitch of the tune as written and learned, nor is it constant for recurrences of the same tune. For example, on April 9th, I found a tune 'in my head' which was perfectly familiar, but for which I could find no words. Tested on the piano, the pitch was f-sharp and the time was my heart-beat.[1] I finally, after much effort, got the unworthy words, "Wait till the clouds roll by," by humming the tune over repeatedly. The pitch is determined, probably, by the accidental condition of the auditory center as respects pitch-readiness, or by the pitch coloring of the external sound, which serves as accidental stimulus to the tune.

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[1] In the case of some of those who carry tuning-forks in their pockets.

[2] *Loc. cit.*, p. 366.

[3] *Loc. cit.*

In explaining pitch recognition the question of relative pitch comes first. The very fact that it is relative, means that it may be brought under the question of conscious recognition in general. If recognition be due to complexity, relationship, 'fringe,' in the representation recognized, and vary with the degree of this associative, or apperceptive element, then recognition of each note would occur, like the recognition of any other presented content, according as it have or have not a train or fringe of associated elements. A tune is then recognized, because it is such a train. The degree of precision in its recognition depends upon the fineness of discrimination at the original hearing of it. So also the fact that notes are better recognized after the musical notation has been learned, simply means that additional elements are brought into the complex by the notation — elements which support the claim of the whole. With persons of the motor type, further, the motor speech and song images are prominent in this complex, and so essential, perhaps, that recognition does not occur without them. It seems likely, therefore, that if we grant differences of pitch in tone sensations, the recognition of the associated trains which we call 'tunes' is but an instance of a broader mental phenomenon.

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[1] Very frequently the case, especially just after eating, as in this instance.

Absolute recognition, on the other hand, or 'absolute hearing,' as it is called, presents anomalies which make it difficult to explain it as an ordinary case of recognition. Either we must find elements of complexity in such tones or confess that here is an exception to all our rubrics. The question is this : can any one identify a note of any pitch simply and only from the tone-quality of the note itself? One of the latest contributions to this question is from v. Kries,[1] who is himself a musician. He possesses the so-called absolute hearing. He also publishes details supplied from other similar cases. He argues that the ability to identify a single isolated note can not be due to musical practice, *i. e.*, can not be a refinement of interval recognition,[2] because (1) he (and others) has had this power from early boyhood, because (2) some of the most celebrated musicians have not been able to acquire it at all, although their sense of interval became most wonderfully acute, and because, (3) the power in himself (and others) varies with the instrument which sounds the note, and is not best with the instruments used most. He recognizes notes from the piano (best), from string (especially the violin), and wind instruments, but not those from tuning-forks, or steam and other whistles, or notes sung, or whistled with the lips — a state of things shown with some variations also in several of his correspondents. Now the violin is with v. Kries a late accomplishment, while he has, of course, been hearing singing all his life, accompanying singers on the piano from his twelfth year, and whistling habitually. Indeed, these last facts — showing the influence of timbre on pitch-recognition — lead him to deny that there are any revived images of any kind belonging intrinsically to musical recognition. He finds it to be a case of *Benennungs-association* as established by Lehmann, *i. e.*, v. Kries was not able to recognize notes until after, in boyhood, he had learned their names and written signs. The case is analagous, therefore, he holds, to the recognitions which Lehmann found to follow from the simple lettering and naming of shades of wool not before separately recognized.[1]

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[1] *Das absolute Gehör*, in *Zeitschrift für Psychologie und Physiologie der Sinnesorgane*, III, 1892, p. 257.

[2] So Stumpf, *loc. cit.*, I, p. 280.

This conclusion of v. Kries is lame, I think. It does not account for the differences due to *timbre* as explained above; for the notation is the same practically for all the instruments and for the voice. v. Kries admits this, and says it remains for the future to provide a theory of this influence due to timbre — leaning, however, as he does to the over-tone theory. Further, he agrees with other observers in finding that chords are better recognized than single notes; this would indicate that recognition is due in some way to the complexity and variety of the tone content, rather than to the accident of naming. It is possible, perhaps, to give due weight to the influence of the name-association in a theory which does more justice to the essential facts. This and other cases of the recognition of apparently isolated sense-qualities can be brought, I think, under the law of "sensori-motor association" which I have formulated in what precedes.

The fact of recognition, in all its obscurity, seems to involve two aspects of feeling which are, in common cases, both equally present, *i. e.*, a subjective and an objective aspect.[2] We have in the recognition of an image not only the identification of it as objectively the same; but also a feeling of 'warmth,' ownership, self-reference. We do not recognize a thing simply *for itself;* we recognize it *for ourselves.* It has become in a sense ours by having been present to us before.

Now, if we find the objective aspect of recognition in the represented complexity of content — spoken of above in connection with relative pitch recognition — the apperceptive or associative meaning of the thing; it still remains to find the more uniform element of subjective reference common to different recognitions. This I find in the *varying degrees of attention* which are necessary for the reinstatement of the image in question in each case; that is, in the motor sensations of adjustment, which are constant for each varying degree of concentration of the attention.

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[1] Lehmann, *Philosophische Studien*, 1889.

[2] Together constituting the 'coefficient' (Höffding's *Bekanntheitsqualität*).

In the principle of "sensori-motor association" we find this motor element in recognition supplied. The motor associates of each sensory intensity are constant, and each degree of motor complexity is associated with the degree of readiness of attention which is represented by its own tendency to stimulate the motor elements of the attention. When, therefore, a presentation comes a second time into consciousness, it is adjusted to more easily because its apperception in attention proceeds upon a basis of ready formed association. This relative ease of adjustment is felt as the subjective aspect of recognition.

In the case of absolute pitch recognition, the objective aspect is wanting — pure tone has no presentative complexity, as v. Kries claims. But the subjective aspect is present in the relative ease of transition from the motor associates of the tone to the motor elements of the attention. This suffices for its recognition.[1]

Several considerations may be urged in favor of this view: (1) It brings absolute and relative tone recognition under a single principle; the former arises on the motor side, the latter on the sensory side, of the original sensori-motor association; (2) it accounts for the greater relative ease of recognition of chords and compound tones; apart from their complexity of content, they carry greater and more varied dynamogenic influence; (3) it makes it possible to consider tone recognition in some cases hereditary, as the facts (*i. e.*, cases of v. Kries and others) seem to require; persons have from birth a tendency to give the attention with greater facility to one class of stimulations than to another — so the doctrine of types teaches. Why may not this difference extend also to different notes? The analysis given above of the speech function leads us to see what refinements are possible in the recognition of words. Even the recognition of particular classes of words, nouns, etc., may be lost while other words are correctly used. Brazier cites a case in which the visual time notation of written music was retained while the pitch notation in the same music was lost. A corresponding refinement on the motor side is all that this theory requires; (4) it enables us to explain the apparent influence of *timbre*, a fact not explained by any other theory. The fact that isolated tones from some instruments are recognized, while from others they are not, I hold to arise from differences in the type of attention exerted in the several cases respectively. A 'visual' musician is most likely to recognize tones from instruments whose manipulation or notation involves much visual attention; an 'auditory,' notes from those which exercise hearing in most varied and exclusive ways; and a 'motor,' notes from those in connection with which muscular attention is at its best. It is remarkable that in all of v. Kries's recognitions the method of learning was probably by visual note-reading — piano, violin, etc. — while his non-recognitions are apparently in cases in which the auditory indications did not include such systematic visual attention — his own voice, voice of others, steam whistles, lip-whistling, etc. Now on the supposition that v. Kries is a 'visual,' that the motor elements of the attention in his case are most readily stimulated from the center for sight, we have a clear application of our law.[1] Further, v. Kries was unable to recognize tones before he learned musical 'naming,' which, it is natural to suppose, was at first visual. The case of musical alexia already quoted from Brazier, shows the importance of a single class of notation memories, although it involved the loss, not of tone-recognition, but of musical execution;[2] (5) one of v. Kries's cases of 'absolute hearing' seems to be, from what he reports of it, motor in its type: a young woman who recognized sung tones, only by means of 'internal repetition' for herself of the note sung (*das Bedürfniss bestand, sie innerlich nachzusingen*).[1] This *innerliches Nachsingen*, in a case where the real note is already heard, is probably motor, a supposition supported by the fact that the woman was a "skilful singer herself." Her quicker recognition of piano tones might be because of the motor practice in hand-execution; (6) this point of view affords us an additional reason for the fact, which all admit, that the best recognitions are for notes of moderate pitch — not very high or very low — for, being of most frequent occurrence, these notes exercise the attention most, and so get most easily and readily accommodated to. And it is also easy to see that, for this reason, their discrimination becomes finer and better; (7) in the experiments already referred to, Féré found different dynamogenic effects to follow the hearing of the different notes of the musical scale, and the greatest effect to follow the notes in the middle of the gamut. Can this be no more than a coincidence?

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[1] Instead of Höffding's sentence (*Phil. Stud.*, VIII, p. 90), "*die organische Functionen gehen leichter*" in absolute recognition, I would say the psychophysical function of attention "goes easier."

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[1] Of course, such an application is only an illustration; the details of the individual's life and education — the questions "why?" and "to what extent?" he is visual, motor, etc. — make any single case extremely complex.

[2] *Loc. cit.*, p. 363.

Finally, if 'motor associates' be at the bottom of pure-tone recognition, we would expect something of the same kind in the case of color and odor qualities. This is the sphere of Lehmann's results in *Benennungsassociation* to which v. Kries appeals. Now Féré claims to have demonstrated this very point, *i.e.*, that color discrimination and recognition are improved by muscular exercise. He found it possible to bring back purple-recognition to purple-blind hysterics, simply by muscular movement. It is a ready deduction, also, from the opposite fact that the different colors, beginning with red, have diminishing dynamogenic effect as measured on the squeeze-dynamometer.

IV. SUMMARY.

I have endeavored in this paper to maintain the following positions:

1. The law of "sensori-motor association" — "every sensational state is a complex of sensor and motor elements, and any influence which strengthens the one tends to strengthen the other also."

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[1] *Loc. cit.*, p. 273.

2. The subjective element of recognition in general is due to the association between the constant "motor ingredients" of mental states, and the motor elements of the attention.

3. All pitch reproduction is auditive. Pitch recognition (absolute) is due to association between the motor ingredients of pitch qualities and the motor elements of the attention.

4. Verbal reproduction is of several types — motor, visual, auditory, etc. Verbal recognition is due to association of the motor elements of that memory image which most readily stimulates the attention, with the motor elements of the attention.

5. The existence of memory types is due to the education of the attention under the operation of the "law of sensori-motor association" : the motor ingredients of a particular kind of memories become in this way implicated, by association, with the motor elements of the attention.

6. The facts that "increased intensity of sensation draws the attention," and that "attention increases the intensity of sensation," are both explained as partial statements of the "law of sensori-motor association."

7. The facts, also, that "increased intensity of stimulus shortens reaction time," and that "motor reactions are shorter than sensory reactions," are explained as deductions from the law of "sensori-motor association." This law also — with the memory types which it produces — explains the discrepancies reported by different observers in the matter of sensory and motor reactions.[1]

J. MARK BALDWIN.

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[1] It is evident that the general position taken in this paper bears in favor of *central*, as opposed to exclusively peripheral, control in voluntary movement. The correlation of various images in the attention, through their respective 'motor ingredients,' is necessary for voluntary activity; and when a particular class of images is lost, the damage it works in the mental life is not alone the narrowing of the content in consciousness, but it is in many cases the withdrawing of that support without which the voluntary function can not proceed at all. It is in the coördination of the attention, therefore — what I have elsewhere called "volitional apperception" — that every one of the incoming sensory elements must have part, at least, of its regulating effect upon the efferent discharge. This is shown so clearly, as a matter of fact in the elaborate article by Pick on the loss of voluntary

movement by certain anæsthetics when the eyes (or ears) are closed (*die sogenannte 'conscience musculaire,' Zeitsc. für Psych.*, IV, 1892, 161 ff.), that I need not do more than recognize the support which my article gets from his. As to the interpretation of the facts, I hope that the principle urged in this paper may be found to take us a step further. A collection of cases which show the extreme dependence of attention and voluntary movement, in persons of the visual type, upon vision, is made by Dr. Ireland in *Journal of Ment. Sci.*, Jan. '93, pp. 130 f. The extraordinary patient of Dr. Grainger Stewart of Edinburgh, whose case Dr. Ireland cites, I myself had the pleasure of examining, through the kindness of Dr. Stewart.